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09/626,106	07/26/2000	Takafumi Morimoto	TPO-13	8044

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EXAMINER

SOUW, BERNARD E

ART UNIT

PAPER NUMBER

2881

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.	09/626,106	Applicant(s)	MORIMOTO ET AL.
Examiner	Bernard E Souw	Art Unit	2881

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) Responsive to communication(s) filed on 26 July 2000.

2a) This action is FINAL. 2b) This action is non-final.

3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4) Claim(s) 1-24 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5) Claim(s) _____ is/are allowed.

6) Claim(s) 1-24 is/are rejected.

7) Claim(s) _____ is/are objected to.

8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9) The specification is objected to by the Examiner.

10) The drawing(s) filed on 26 July 2000 is/are: a) accepted or b) objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11) The proposed drawing correction filed on _____ is: a) approved b) disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.

12) The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a) All b) Some * c) None of:

1. Certified copies of the priority documents have been received.
2. Certified copies of the priority documents have been received in Application No. _____.
3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14) Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) The translation of the foreign language provisional application has been received.

15) Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) Notice of References Cited (PTO-892)

2) Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) Information Disclosure Statement(s) (PTO-1449) Paper No(s) 4.

4) Interview Summary (PTO-413) Paper No(s). _____.

5) Notice of Informal Patent Application (PTO-152)

6) Other: _____.

DETAILED ACTION

Priority

1. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Specification

2. The disclosure is objected to because of the following informalities:
 - (a) Page 10, line 6, " by the time charts of FIG. 5 or FIG. 8 ...".
FIG. 8 does not show any time chart.
 - (b) Page 29, line 1, " ... is *an* light .." should correctly read " ... is *a* light .."
Appropriate corrections are required.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.
4. Claims 1, 8 and 22 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The terms "the state of servo control is *continued*" in claim 1, "while *continuing* the state of servo control" in claim 8, and "while *continuing* the control relating the distance between said probe and said sample" in claim 22, stand in direct contradiction to the disclosure referring to Applicant's Figs. 1, 3, 4 and 6, based on the voltage

signals s1 and Vz characterizing the state of the servo controller illustrated in Figs. 2 and 5, which obviously demonstrate a state of the servo control *not being continued*, or *held constant*, as claimed, but is changed with time in a periodic manner. Consequently, all the dependent claims 2-7, 9-13 and 23, are also rejected under the same paragraph.

To proceed with this Office Action the term “*continued*” or “*continuing*”: is simply ignored by the Examiner.

5. The term “wide” in claims 6, 12, 14, 16, 19 and 22, is a relative term which renders the claims indefinite. The term “wide” is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. Consequently, all the dependent claims 15, 17-18, 20-21, 23 and 24 are also rejected under the same paragraph.

To proceed with this Office Action, the indefinite term “wide” in said claims is simply ignored by the Examiner.

6. . The term “high” in claims 7 and 13 is a relative term which renders the claims indefinite. The term “high” is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention.

To proceed with this Office Action, the indefinite term "high" in said claims is simply ignored by the Examiner.

Claim Rejections - 35 USC § 102

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

8. Insofar as the examiner can ascertain beyond the above rejections under the 2nd paragraph of 35 U.S.C. §112, claims 1, 8, 19, 20, 22 and 23 are rejected under 35 U.S.C. 102(b) as being anticipated by Kajimura et al. (USPAT 5,394,741, hereafter denoted as Kajimura-741, to distinguish from other Kajimura's listed in PTO-892 here attached).

Kajimura-741 et al. disclose a scanning probe microscope (SPM) as illustrated in Figs.1, 7, 9 and 10, and recited in the relevant parts of the specification, comprising :

- a cantilever 16 having a probe 14 close to the surface of a sample 12, as recited in Col.4/II.61-64;
- an actuator 20 provided with the cantilever 16 for changing a distance between the probe 14 and the sample 12, as recited in Col.5/II.12-15;
- a displacement detection system consisting of mirror 18, semiconductor laser 24, and photodiode 34,. For detecting displacement of the probe 14, as recited in Col.5/II.27-68, Col.6/II.1-68, and Col.7/II.1-5; and

- a servo controller 38 outputting a control signal for controlling the operation of the actuator 20 based on a detection signal output Pa, shown in Fig.6 and recited in Col.7/II.11-15, relating to a reference distance and holding a distance between the probe and the sample at the reference distance in measurement at a sampling position, as recited in Col.7/II.26-36; wherein
- the probe 14 scans the surface of sample 12 to measure the surface, as disclosed in Col.7/II.33-40, while holding the distance between the probe 14 and the sample 12 at the reference distance associated with the detector output signal Pa recited above, at each plurality of a plurality of sampling positions (X,Y), as recited in Col.7/II.20-23 and Col.10/II.63-65;

Kajimura-741's SPM device further comprises:

- an approaching and separating means, i.e., a Z-drive device not shown in Kajimura-741's figure drawings but explicitly recited in Col.7/II.16-19, for controlling the operation of the actuator 20 (through the servo controller 38) so as to make the probe 14 approach to the sample surface 12 for measurement at each of the sampling points, as recited in Col.10/II.63-65 already mentioned above, and then make the probe 14 separate from the sample surface, as is inherent in the operation of any SPM device;
- the limitation "wherein the state of the servo control by said servo controller is *continued*" is simply ignored (i.e., eliminated) by the examiner. However, insofar as the examiner can ascertain beyond the above rejection under 35 USC §112 2nd paragraph, the limitation would have been anticipated by Kajimura-741 et al. by a timely varying servo control signal, as described in Col.7/II.16-43.

► Regarding claims 6, 7, 12 and 13, insofar as the examiner can ascertain beyond the above rejections under the 2nd paragraph of 35 U.S.C. §112, recitation of definite sizes in place of the relative terms “wide” and “high” would not lend any patentability to the respective claim, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable range involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

Generally, limitations relating to the dimension of a claimed device or step is not sufficient to patentably distinguish over the prior art. *In re Rose*, 220 F.2d 459, 105 USPQ 237 (CCPA 1955).

Mere scaling up of a prior art process capable of being scaled up would not establish patentability in a claim. *In re Rinehart*, 531 F.2d 1048, 189 USPQ 143 (CCPA 1976), 531 F.2d at 1053, 189 USPQ at 148. In this regard, scaling up of the scan range of the prior art SPM device and the aspect ratio it can handle, are possible and also well known in the art.

► Regarding claim 8, the additional limitation of “a movement mechanism for making the probe 14 scan the surface of the sample 12” is anticipated by Kajimura-741 et al. with the XYZ scanner 13 and recited in Col.7/II.20-23.

► Regarding claim 9, Kajimura-741’s method of SPM includes an additional step of adding a signal used for the approach and separation produced by an auxiliary Z-drive (not shown but recited in Col.7/II.9-19) to the signal appropriate to make the output of detector 34 (or 36) equal to Pa shown in Fig.6, which relates to the reference distance between the probe and the sample, as recited in Col.6/II.50-66. The adding step is

here performed by the Z-scan of the XYZ scanner driven by servo 9, as recited in Col.7/II.26-34, the latter being physically separated from the Z-drive used for the approach and separation. However, the combined result is effectively an addition of the Z-distance from the XYZ scanner 14 and the Z-distance from the piezoelectric inchworm 31. In this case the signal addition effect must not necessarily be made by the method suggested by the Applicant. If the method suggested in the prior art produces the same effect as claimed, it meets the claim.

The further limitation of performing the signal addition in a control loop of the servo controller is a mere matter of design, or process, choice, which does not lend patentability to the claim.

► Regarding the (additional) limitations of claim 19, Kajimura-741's SPM device is provided with:

- an actuator 20 made of piezoelectric material, as recited in Col.5/II.12-15;
- a combining means inherently included in control circuit 38 for combining a voltage signal determining the reference distance (inherently produced in 38 when the detector output of 36 reaches the predetermined level Pa) and the approach-separation voltage signals provided by an auxiliary Z-drive device (not shown but recited in Col.7/II.16-19), as described in Col.7/II.29-36;
- a subtracting means for calculating a difference between a voltage signal output by the combining means in control circuit 38 and the detection signal from the detector 36 ($\neq Pa$), which is inherently included in 38 for keeping the detector output level remain at Pa , as recited in Col.7/II.25-32;

- wherein the control circuit 38 generates a control voltage signal based on said differential signal and supplies the voltage signal (over XYZ scanner 13) to control the approach and separation movement, as recited in Col.7/II.29-32.
- the further limitation of a combining means for combining a voltage signal determining the reference distance given by the detector 36 in Fig.6 and the approach-separation voltage signal given by the Z-drive is the same as that of rejected claim 9 above. Further, Kajimura-741's SPM device comprises a subtracting means 38 for calculating a difference between a voltage signal output by the combining means (Z-drive) and the detection signal from 36 to output a difference signal, wherein the control circuit 38 generates a control signal based on the differential signal and supplies the signal to the piezoelectric element 20 to control the approach and separation movement.

► Regarding claim 20, the additional limitation of holding the approach-separate voltage (provided by the not-shown Z-drive, see above) in a separation state when moving from one sampling position to a next sampling position, is a trivial limitation inherently understood in the art, since otherwise the whole height profile between the one sampling position to the next sampling position would have been measured and imaged by the device.

► Claim 21 is rejected for having limitations which are the same as those of already rejected claims 19 and 2, or 4, combined.

► Regarding claim 22, the additional limitation of a "wide area" of scan is ignored (eliminated) by the examiner upon obviation of the above rejection under 35 USC §112

2nd paragraph. However, insofar as the examiner can ascertain beyond the above rejection under 35 USC §112 2nd paragraph, any specific limitation on the size of the XY scan will be considered as a mere optimization of Kajimura-741's device that does not disclose any specific scan range. It has been held by the court that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Generally, limitations relating to the dimension of a claimed device or step is not sufficient to patentability distinguish over the prior art. *In re Rose*, 220 F.2d 459, 105 USPQ 237 (CCPA 1955).

Mere scaling up of a prior art process capable of being scaled up would not establish patentability in a claim. *In re Rinehart*, 531 F.2d 1048, 189 USPQ 143 (CCPA 1976), 531 F.2d at 1053, 189 USPQ at 148.

► Regarding claim 23, the additional limitation of an actuator 20 made of piezoelectric material, is recited in Col.5/II.12-15.

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. Insofar as the examiner can ascertain beyond the above rejections under the 2nd paragraph of 35 U.S.C. §112, claims 2, 3, 4, 10 are rejected under 35 U.S.C. 103(a) as

being unpatentable over Kajimura-741 et al. as applied to claims 1, 8 above, and further in view of Hosaka et al. (USPAT 5,467,642, hereafter denoted as Hosaka-642, to distinguish from other Hosaka's listed in PTO-892 here attached).

11. Kajimura-741 et al. recite all the limitations of claim 2 as applied to claim 1 above, including that Kajimura-741's actuator 20 is made of a piezoelectric material, as recited in Col.5/ll.12-15, except the recitation of a periodic pulse signal for approach and separation.

Hosaka-642 discloses a SPM similar to Kajimura-741's, as illustrated in Figs.1, 5, and 6. The various parts of Hosaka-642's apparatus, including the z-movement of the probe 17, are controlled by control unit 45 through the XYZ scanner 14 and the piezoelectric inchworm 31, as recited in Col.4/ll.19-22, in accordance with a predetermined schedule of operation, as recited in claim 1/lines 11-12. Hosaka-642's scheduled operation is repeated at regular time intervals, i.e., periodic, as recited in claim 6.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to repeat the scheduled operation of measurement in a periodic manner according to Hosaka-95's scheme, in order to perform a two dimensional (x-y) scan with the sequential y-scans begun at the same starting x-position

It would have been further obvious to one of ordinary skill in the art at the time the invention was made to eliminate certain steps in Hosaka-642's scheduled operation, in this case Hosaka-642's correction steps to compensate for probe deformation (steps

1-6 in Fig.3a-c, recited in Col.7/II.13-67 and Col.8/II.1-6), since elimination of a step or an element and its function is obvious if the function is not desired.

12. Regarding claim 3, Hosaka-642's probe 17 is set along the Z-axis by a piezoelectric inchworm 31, as recited in Col.4/II.7-10. It is well known in the art that an inchworm is conventionally equipped with a displacement meter that enables a direct reading of the amount of displacement due to expansion and contraction of the piezoelectric element 31.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use an inchworm that directly gives the amount of displacement due to expansion and contraction of the piezoelectric element, in order to be able to measure displacements independent from the instantaneously applied voltage.

The motivation to use a displacement meter is already implicated by Kajimura-741 in another embodiment of their invention, in which a rough z-movement mechanism, as recited in Col.10/II.51-55. Since this rough z-movement mechanism is decoupled from the instantaneous voltage applied through the controller circuit, one of ordinary skill in the art would be advised to use an inchworm, in order to directly obtain the amount of displacement.

13. Regarding claims 4 and 10, Hosaka-642's actuator is comprised of a first piezoelectric element 47 shown in Fig. 5 and 6 for normal measurement, as recited in

Col.9/II.29-33, and a second piezoelectric element 31 for extension and extraction, as recited in Col.9/II.42-45 and Col.10/II.7-8. Hosaka-642's SPM further comprises:

- a signal output from the servo controller (consisting of driver 48, servo circuit 9 and deflection detection circuit 5) is given to the first piezoelectric element 47; and
- a periodic pulse signal for approach and separation is given to the second piezoelectric element 31, as already addressed in the above rejection of claim 2.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Kajimura-95's SPM by Hosaka-642's two separate piezoelectric elements, since such a decoupling of the second piezoelectric element from the first one would enable the SPM perform a longer approaching & separating z-distance.

Hosaka-642's purpose of using the first piezoelectric element may be different than Applicant's. However, it has been held that a recitation with respect to the manner in which a claimed apparatus, including its individual parts, is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus satisfying the claimed structural limitations. *Ex parte Masham*, 2 USPQ 2d 1647 (1987).

Instead of using the first piezoelectric element 47 for correction due to probe deformation, as in Hosaka-642's, one would have been motivated to use it for a reference distance to keep the contact pressure between the probe and sample constant, as implicated by the voltage V_f in Hosaka-642's Fig.3(c), since here a correction for probe deformation is considered unnecessary (see above rejection of claim 2).

14. Insofar as the examiner can ascertain beyond the above rejections under the 2nd paragraph of 35 U.S.C. §112, claims 5, 11, 14 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kajimura-741 et al. in view of Hosaka-642 et al. as applied to claims 4 and 8 above, and further in view of Hosaka et al. (USPAT 5,162,653, hereafter denoted as Hosaka-653, to distinguish from other Hosaka's listed in PTO-892 here attached).

Kajimura-741 et al. as modified by Hosaka-642 et al. disclose all the limitations of claims 5, 11, 14 and 16 as applied to claims 4 and 8 above, except the recitation of a separately provided auxiliary movement mechanism to make the probe move in tandem at an equal speed in the same direction as the scan motion.

This is, however, a *trivial limitation* well-known in the art as being necessary to avoid friction along the scan direction due to relative probe-sample motion during a high speed height profile measurement, in which the x-y scan is not intermittent, but proceeds in a continuous manner. This Official Notice of providing an auxiliary and additional x or y scanning mechanism is supported by Hosaka-653 et al., showing in Fig.3 a probe tip 2 which is attached to a X-piezo 6 and Y-piezo 7, which enables both X- and Y-scanning in addition to a Z-movement provided by Z-piezo 1, as recited in Col.4/II.1-2.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the SPM previously suggested by Kajimura-741 modified by Hosaka-642's piezoelectric inchworm, further by adding a X-scan and Y-scan

piezoelectric element(s) as taught by Hosaka-653 et al., and finally, by moving Hosaka-642's probe and Hosaka-653's X-scanner 14 in the same direction, to avoid friction along the scan direction due to relative probe-sample motion during a high speed height profile measurement, in which the x-y scan is not intermittent, but proceeds in a continuous manner.

It would have been desirable to make the steps of approach and separation during movement between sample positions, since it would save scan-time during a wide scan-area.

15. Claim 15 and 24 recite the limitation of scan movement in millimeter units of length, whereas the prior arts – while performing the same as Applicant's device – does not specify any scan range limitation.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to scan a sample using the device of Kajimura-741 as modified by Hosaka-642 and Hosaka-653 in the millimeter units of length, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

Generally, limitations relating to the dimension of a claimed device or step is not sufficient to patentability distinguish over the prior art. *In re Rose*, 220 F.2d 459, 105 USPQ 237 (CCPA 1955).

Mere scaling up of a prior art process capable of being scaled up would not establish patentability in a claim. *In re Rinehart*, 531 F.2d 1048, 189 USPQ 143 (CCPA 1976), 531 F.2d at 1053, 189 USPQ at 148. In this regard scaling up of the scan range of the prior art SPM device is well possible by simply making the interval of sampling positions between the periodic approaching & separating movement of the probe sufficiently large to result in millimeter lengths when multiplied by the number of the samplings being made.

16. Claim 17 recites limitations which comprise combinations of those of claim 16 and claim 2, or 4, or 21, all having been previously rejected.

17. Insofar as the examiner can ascertain beyond the above rejections under the 2nd paragraph of 35 U.S.C. §112, claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kajimura-741 et al. in view of Hosaka-642 et al. and Hosaka-653 et al., as applied to claim 16 above, and further in view of Okada et al. (USPAT 5,289,004).

Kajimura-741 et al. as modified by Hosaka-642 et al. and Hosaka-653 et al. disclose all the limitations of claim 18, as applied to claim 16 above, except the limitation of a reverse scan motion performed each time a scan motion for tandem movement ends.

Okada et al. disclose a SPM very similar to Kajimura-741's, Hosaka-642's and Hosaka-653's, with the X-scan performed by piezoelectric actuator 2 shown in

Figs.1,2,4 and 6 according to a voltage signal shown in Fig.8 curve b, as recited in Col.10/II.46-52.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the SPM previously suggested by Kajimura-741 modified by Hosaka-642 and Hosaka-653, further by performing a reverse X-scan as suggested by Okada et al. each time a scan motion for tandem movement ends, since that is the most simple and direct way to increase the accuracy and reproducibility of SPM measurement by taking an average of multiple series of data.

To obtain a highly accurate and highly reproducible data by simple means is generally desirable in all type of measurements.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Bernard E Souw whose telephone number is 703 305 0149. The examiner can normally be reached on Monday thru Friday, 9:00 am to 5:00 pm..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John R Lee can be reached on 703 308 4116. The fax phone numbers for the organization where this application or proceeding is assigned are 703 872 9318 for regular communications and 703 872 9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703 308 0956.

bes
June 6, 2002



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